

DECISION-SUPPORTIVE FRAMEWORK TOWARDS SUSTAINABLE ADAPTIVE REUSE OF HISTORIC BUILDINGS IN SRI LANKAN CONTEXT

JAYAKODY J.P.N.S.^{1*}, MUNASINGHE J.M.² & HEWAWASAM C.³

^{1,2,3}Department of Town and Country Planning, University of Moratuwa, Sri Lanka

¹nipunijayakody1999@gmail.com, ²jagathnm@uom.lk, ³chamalih@uom.lk

Abstract: The research paper explores the sustainable adaptive reuse of historic buildings within the Sri Lankan context, addressing challenges and proposing a decision-making framework. It emphasizes the importance of adaptive reuse in urban conservation and regeneration. Through an empirical approach and extensive literature review, key factors influencing project success are identified, leading to the development of a dynamic decision-supportive framework. Despite encountering limitations, such as custodian reluctance, the research perseveres, drawing insights from diverse case studies. The findings underscore the framework's adaptability and its potential application in various settings. The paper concludes by advocating for ongoing refinement and validation of the framework to empower stakeholders in navigating the complexities of adaptive reuse projects and ensuring the sustainable conservation of Sri Lanka's historic treasures.

Keywords: *Adaptive reuse, Sustainability, Decision Support framework, Urban conservation, Historic Buildings*

1. Introduction

Adaptive reuse of buildings involves repurposing of historic structures for new functions or uses. This method serves as a means of urban conservation, preserving buildings of historical or cultural significance. Moreover, adaptive reuse plays a significant role in urban regeneration and improving functionality. This method is widely adopted worldwide and is notably common in Sri Lanka.

In different contexts, historic buildings have to deal with the challenges of conservation under adaptive reuse. Reuse policy encounters several challenges, including the lack of reliable information, technicians, skilled labor, compatible materials, compatible laws, and legislation with the requirements for use, views on the buildings by the community and government agencies, the continuity and promotion of the community's life, and the management of pollutant and risky materials (Jasim & Ismaeel, 2023)

In most cases, concerns regarding waste of funds on conservation projects arise because there is no explicit framework to support such decisions for conservation and adaptive reuse (Shiple, Utz, & Parsons, 2006). The absence of proper pre-implementation evaluation has led many projects to encounter serious economic, social, and environmental issues (Bullen & Love, 2011).

Adaptive reuse is becoming a common practice, so it is critical to have a sound framework to support the decisions of the implementing agencies to determine whether the proposed projects would be worthy to invest upon and develop. Such a framework will also help to choose the highest and best use for the existing old buildings. This research is an effort to develop a criterion as the basis for decision supportive framework to implement adaptive reuse of historically important, architecturally values and emotionally attached old buildings in Sri Lankan urban context.

1.1 RESEARCH PROBLEM

In Sri Lanka, there's a growing trend of adaptive reuse of historic buildings, showing a change in how conservation is approached.

The government, private parties, or private-public partnerships are involved in the conservation of historic buildings in Sri Lanka owing to their cultural and historical significance. Many historically significant structures that are not functioning well are situated in prime locations of urban areas. In many cities, there are ancient buildings that are either malfunctioning or abandoned and situated mostly in commercially significant locations (De Silva, Perera, & Rodrigo, 2019a).

Here, several laws and ordinances, including the Antiquities Ordinance of No. 9 of 1942 and conservation management plans embedded in municipal development programs, establish legal access for Sri Lankan context for conservation.

*Corresponding author: Tel: +94714147850 Email Address: nipunijayakody1999@gmail.com

FARU Journal: Volume 11 Issue 02 DOI: <https://doi.org/10.4038/faruj.v11i2.323>

Choosing adaptive reuse requires significant financial and time commitments for refurbishment and maintenance. In some cases, the structure and fabric of buildings may have deteriorated to the point where high levels of maintenance and repair are required, which can affect the building's usage (Love, 2011).

On the other hand, early renovation and maintenance actions may stop the degradation. But at the same time, it restricts adding new elements or changing the structure by garage and elevator extensions, which limits user-desired improvements and adaptability to modern needs due to its structure. This leads to the query, "What is the economically, socially, and technically sustainable solution for using historic buildings in Sri Lankan Context in fruitful manner ?" (Figure 1)

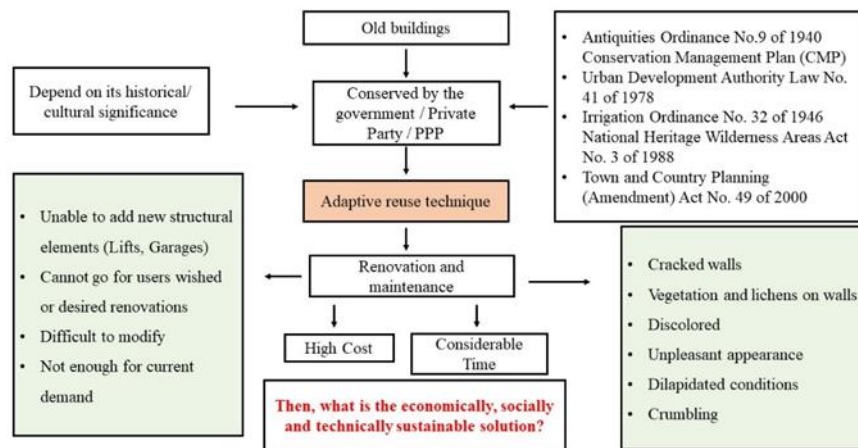


Figure 1: Current scenario of the adaptive reuse practice of Sri Lanka.
(Source: Developed by author through own observations)

Thus, the research is aiming to explore decision making and evaluation methods around the globe and identify the factors that affect the sustainability of adaptive reuse conservation projects in the Sri Lankan context and to establish a decision framework to support the appropriate selection of conservation projects for investment.

2. Literature review

'Adaptation' is derived from the Latin ad (to) and aptare (fit) (Douglas, 2002). There are multiple definitions that have popped up regarding the "adaptive reuse" concept. As Bullen, (2007) shows, adaptive reuse is "a process that changes a disused or ineffective item into a new item that can be used for a different purpose." The adaptive reuse of a historic building should have a minimal impact on the heritage significance of the building and its setting (Department of Environment and Heritage, 2004). Therefore, the significance of the building should not be reduced, while no structural change should be expected for adaptive reuse projects. Enache, (2014) states that one of the most crucial strategies for maintaining current buildings is adaptive reuse, which involves changing the use of a structure after it reaches an identifiable stage of maturity within its life cycle.

When it comes to historic buildings, the previously mentioned principles should not be changed. In this context, adaptive reuse can be defined as the reusing process of a historic building adapted to serve a different function than the original function that was assigned.

2.1 FACTORS AFFECTING FOR SUCCESSFUL ADAPTIVE REUSE

The decision to give the green light to the implementation of adaptive reuse project should be handled carefully. That decision should be treated from several perspectives. As discussed in P. Bullen & Love, (2011), the political, economic, social, environmental, and technological components constantly interact to influence the decision-making process

According to the research of De Silva et al., (2019a), certain parameters may have an impact on adaptive reuse buildings either directly or indirectly. According to the different research papers, here are some criteria that impact the sustainability of adaptive reuse projects.

- Greenery
- Environmental impact
- Gentrification
- Safety and security
- Site attractiveness
- Dismantlability
- Interaction with urban shape
- Demolished Buildings
- Architectural quality
- Minimum intervention

- Livability
- Walkability
- Raising public awareness
- Cultural Value
- Profitability
- Economic feasibility
- Self-sustaining
- Attractive location
- Functional Potential
- Services
- Space flexibility
- Explicitness of alterations
- Upgrading physical characteristics around
- Age value of materials
- Predicting seismic resilience
- Load- bearing structure.
- Technological innovations
- Orientation and solar access
- Respecting the preservation rules and provisions
- Compatibility with zoning and (urban)planning requirements
- Public-private partnership

2.2. DECISION SUPPORT SYSTEMS

Subsequently, the researcher has explored decision making and evaluation methods around the globe. There are two different kinds of decision-support systems: decision-support models and decision-support frameworks.

2.2.1. Decision Support Models

Decision-support models function at different phases of a building's life cycle, offering chances to make well-informed decisions regarding adaptive reuse. There are various types of such models. Such as Adaptive reuse potential model by Longston and AdapSTAR model by Conejos and Longston etc. Literature emphasizes their applicability in enhancing selection for adaptive reuse, stressing the need for flexible decision-making throughout a building's lifespan. (Figure 2)

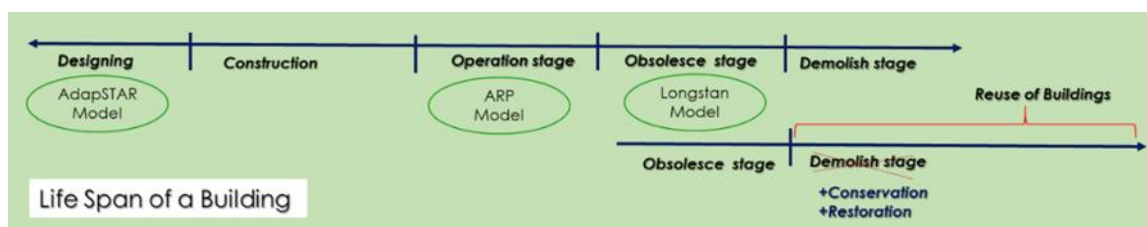


Figure 2: Decision taking for adaptive reuse projects in different stages of the lifespan of a building.

(Source: Developed by the researcher using (Samaranayake, Jayawickrama, Melagoda, & Rathnayake, 2019), (Conejos & Langston, 2010))

2.2.2. Decision Support Frameworks

The array of research on decision-support frameworks for the selection of old structures for adaptive reuse projects is far smaller than that on decision-support models. Previous research frequently concentrates on selecting the optimal project from a set of options within a particular case study or assesses reuse project selection through the use of expert teams. Here the Multi-Criteria Decision Analysis (MCDA) techniques are used, which emphasizes their importance in decision-support frameworks. (Vizzarri, Sangiorgio, Fatiguso, & Calderazzi, 2021)

2.3. ADAPTIVE REUSE AND SRI LANKAN CONTEXT

There is an immense absence of awareness in the Sri Lankan setting when it comes to the selection of adaptive reuse projects. Adaptive Reuse Buildings (ARB) are the best option available to make optimum use of these buildings. Unlike developed countries, developing countries, including Sri Lanka, have not yet appropriately embraced ARB (De Silva et al., 2019b). The major lack of knowledge demonstrates itself from the decision to choose such a project to the upkeep of the adaptively reused structures to ensure their sustainability. The rationale for selecting these projects doesn't seem to be well understood, and this ignorance raises the question of how successful adaptive reuse initiatives are in attaining long-term profitability.

Due to Sri Lanka's large availability of ancient and colonial structures, the government has pursued conservation or conversion efforts, frequently adopting international trends. In Sri Lanka, the majority of buildings that have been reused are colonial buildings of historical value (De Silva et al., 2019b). Notable attempts, for example, include the construction of five-star hotels on the site of the former Bogambara prison and the Nuwara Eliya Post Office buildings.

2.4. RESEARCH GAP

In Sri Lanka, it's important to conduct research that is specific to the local context and develop a decision-support framework that blends with the complexities of the local environment. Concerns concerning the viability and suitability of the selected adaptive reuse projects are raised by the knowledge gap, which is made especially clear when considering the shortcomings

and possible dangers of the existing strategy. To effectively conserve and repurpose historic structures in Sri Lanka, it is imperative that this research vacuum be filled.

3. Research Methodology

The study has adopted an empirical approach, acknowledging that, as the literature review demonstrated, adaptive reuse initiatives include a wide range of criteria. Because of its multidisciplinary nature, it requires a methodology that enables thorough data gathering and analysis. The empirical approach also provided researcher with the freedom to collect data via interviews, literature reviews, observations and many more, and to validate data by triangulating information from multiple sources, ensuring a strong and unbiased result.

According to the Vizzarri et al., (2021) mentioned in their research multiple criteria has used for a holistic approach for the adaptive reuse project selection. The important of this study is incorporating both quantitate and qualitative parameters to support the decision taking on adaptive reuse projects. Therefore, this study has been considered important as it provided opportunity in identifying the critical factors impact in decisions regarding successful adaptive reuse. This list was adjusting and updated by the researcher to have a broad understanding on the impact of such mentioned criteria for success of the adaptive reuse projects. The research question is concisely stated as follows:

"What factors out of the above-mentioned framework are critically important to be considered in making decisions on sustainable adaptive reuse of historic buildings in the Sri Lankan context?"

3.1 METHOD OF STUDY

Accordingly, in this study, by evaluating the current status of the projects, the matters considered by the respective agencies at the pre-implementation project process are evaluated in order to test what impacts such considerations would have impacted the current status (success or failure) of the project.

Here the current state, that is success or failure of the projects have been decided based on the following:

- Researcher's observations
- Opinions of the custodians and management parties
- Opinions of the users of the places

3.2 CATEGORIZATION OF THE CRITERIA

The adjusted criteria list was categorized into groups based on similarities among the multiple criteria during the analysis process. The key features of each element are called "Main criteria," and the more specific criteria that come under these main criteria are called "sub-criteria,". The purpose of this classification is to make components more understandable and

clearer. Altogether there are 31 sub criteria which will affect the decision of selecting a project for adaptive reuse under 07 main criteria. Main criteria were also made based on the common features of the sub criteria. The 31 criteria identified from the research papers were incorporated into this paper, forming a foundation for selection. These criteria can be tested and used for data collection, depending on the time available.

The interaction of the research question, sub criteria, main criteria, and the way how it connects with the decision-making process to go with the end result for predicting as successful or failure adaptive reuse project. (Figure 3)

3.3 DATA COLLECTION AND ANALYSIS

Three primary methods were used for data collection: document examination, interviews, and on-site observations. Here observations were conducted on-site provided firsthand knowledge of the real circumstances, with criteria either fully or partially met. Project documents, books, journal articles, and web-scraped articles from newspapers were used in the document review process to evaluate the reliability of the criteria. Interviews with users, custodians, site managers, and decision-makers were conducted as informal meetings to obtain their views on the initiatives. Here, the other resources were also used for data gathering. Such as Google Maps, satellite images, project websites, photographs, ArcGIS, and Google Earth Pro to analyze criteria.

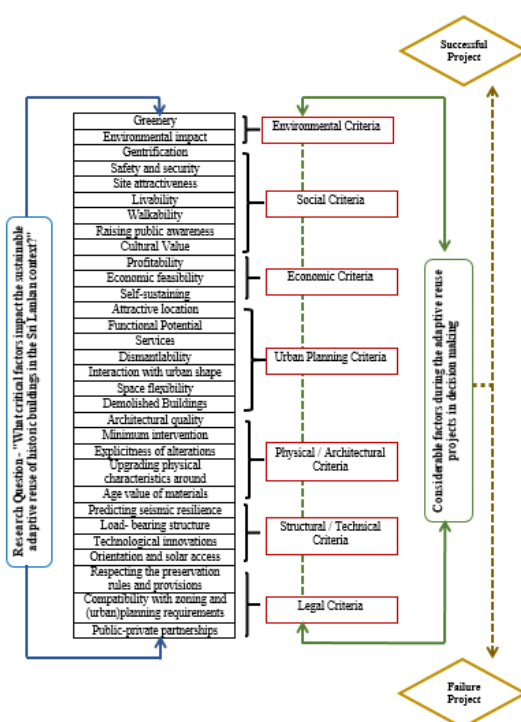


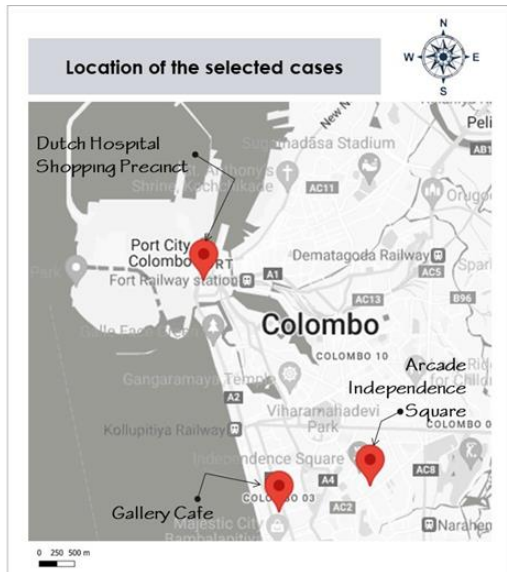
Figure 3: Interconnection of the research question, literature findings and target objective.
(Source: Developed by author.)

3.4 STUDY LOCATIONS

The criteria that were found in the literature review were tested in the three locations of Colombo.

- The Dutch Hospital Precinct
- The Arcade-Independence Square
- The Gallery Cafe

It is going to evaluate the framework with a set of criteria and these cases are using to support it. (Map 1 , Figure 4 – Figure 6)



Map 1: Locations of the selected cases.
(Source: Developed by author)



Figure 4: Dutch Hospital.
(Source: Taken by author during the site visits.)

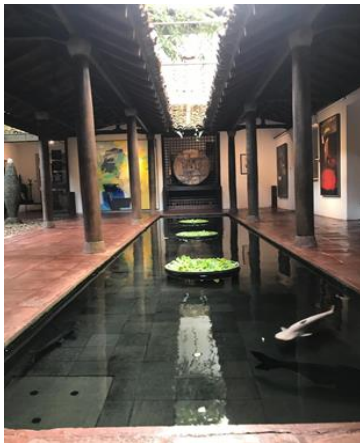


Figure 5: Gallery Cafe
(Source: Taken by author during the site visits)



Figure 6: Independence Arcade Square
(Source: Taken by author during the site visits.)

4. Data Analysis

4.1. DETERMINING THE SUCCESS OR FAILURE OF THE SELECTED CASES

Here the informal meetings with mentioned parties provided valuable insights while researcher's observations also aided in identifying key factors contributing to project outcomes. The majority of the opinions were considered in reaching final conclusions about project success or failure. This approach ensured a comprehensive assessment of each case study, drawing from diverse perspectives and experiences. (Table 1 and 2)

Table 1: Considering factors for determining the success or the failure of the selected cases.

	Case 01- Dutch Hospital Precinct	Case 02- Arcade Independence Square	Case 03- Gallery Café
Location in Colombo	Colombo 01	Colombo 07	Colombo 03
Ownership	Government (UDA)	Government (UDA)	Private party
Number of days active per week	07	07	07
Number of hours open per day	12 hrs.	14 hrs.	14 hrs.
Total number of Shops	14	42	1
Total number of operating shops	All	06	All
Target Market	High-end individuals and Middle-income	High-end individuals	High-end individuals
Activities	Dine in, shopping, Entertainment activities	Dine in, shopping, Entertainment activities	Dine in, buying local arts and craft, Art Gallery watching
Famous for / Main revenue generating method	Dine in/Shopping/ Events	Taking for photoshoots	Private Dine in/ Events
Number of users per day	4000-5000	400-500	300- 400
Average number of visitors for shops	2000-3000	100-200	
Average number of visitors just visit place and roaming	1500-2000	400-500	10-15
Monthly rental per square feet	Rs. 262.00	Rs. 500.00	No*

No* - Custodians didn't disclose the information regarding on that.

Table 2: Status of the selected cases

	Case 01- Dutch Hospital Precinct	Case 02- Arcade Independence Square	Case 03- Gallery Café
Researcher's Observations	Yes	No	Yes
Users	Yes	No	Yes
Custodians (Shop Owners)	Yes	No	Yes
Management Party	Yes	Yes	
Result	Success	Failure	Success

In assessing the success or failure of the selected projects, specific insights were considered, including the ownership structure of the study locations, the number of shops actively operating relative to the total number of shops, the target market, the primary revenue-generating method, and overall economic feasibility. These factors provided a comprehensive basis for evaluation based on the opinions gathered.

4.2. ANALYZING THE CRITERIA

During the analysing the criteria, the level of affecting the particular criteria in three stages as, before intervention, during the intervention and current status. Based on analysing each criterion, below table was made by identifying the impact of criterion to the level of success for the project. (Table 3) The extent of influence of each criterion depicts through it as low (green color), moderate (yellow color) and high (red color). This visualization provides a comprehensive overview of the research findings, aiding in understanding adaptive reuse project dynamics.

Table 3: The level of the criteria might affect to the level of success of the three cases

	Dutch Hospital	Arcade Independence Square	Gallery Café
Success or the failure of the project	Success	Failure	Success
1) Greenery		High	Moderate
2) Environmental impact	Moderate	Moderate	High
3) Gentrification			
4) Safety and security	High	Moderate	High

5) Site attractiveness	Moderate	Low	High
6) Livability	Moderate	Moderate	Moderate
7) Walkability	High	Low	
8) Raising public awareness			High
9) Cultural Value	Moderate		High
10) Profitability			High
11) Economic feasibility			High
12) Self-sustaining	Moderate		High
13) Attractive location	High		High
14) Functional Potential	Moderate	Low	
15) Services	High	Low	Moderate
16) Dismantlability	Moderate		
17) Interaction with urban shape		High	
18) Space flexibility	High	High	High
19) Demolished Buildings		High	
20) Architectural quality	High	High	High
21) Minimum intervention	High	High	High
22) Explicitness of alterations	High	High	
23) Upgrading physical characteristics around			
24) Age value of materials	Low	High	High
25) Predicting seismic resilience			
26) Load-bearing structure		Moderate	
27) Technological innovations			High
28) Orientation and solar access		Moderate	
29) Respecting the preservation rules and provisions			
30) Compatibility with zoning and (urban)planning requirements	Moderate	Moderate	
31) Public-private partnerships			

5. Conclusion

The research aims to develop an explicit framework for decision-making in adaptive reuse projects, focusing on economic, social, and technical sustainability. Through comprehensive literature review, critical criteria were identified and categorized into seven main factors. Success or failure of selected cases was determined through stakeholders' opinions, revealing key insights into project success factors. This research paper makes both theoretical and practical contributions. In the selected study locations, criteria related to economic viability, architectural quality, and urban planning appear to be particularly influential in achieving successful outcomes. Additionally, effective collaboration among conservation and management teams, combined with a clear understanding of the building's intended purpose, is essential. Thoughtful consideration of the proposed function or use is necessary to ensure both the viability and long-term sustainability of adaptive reuse projects. Limitations include potential criteria oversights and custodians' reluctance to disclose financial data.

The study's scope and timeframe constrained broader applicability, but it lays groundwork for future research, inviting further exploration and validation of the framework for informed decision-making in adaptive reuse projects.

The novelty of this research lies in several key aspects. First, it employs an empirical approach for data collection and analysis, providing a solid foundation for evaluating both quantitative and qualitative criteria that impact the success of adaptive reuse projects within the Sri Lankan context. Additionally, it introduces an initial decision-support framework aimed at guiding sustainable adaptive reuse efforts in Sri Lanka.

This framework offers a starting point for future research by highlighting the potential for additional criteria—whether primary or secondary—that may further inform adaptive reuse practices. This study invites ongoing exploration and refinement to enhance and validate the criteria, supporting more informed decision-making in adaptive reuse projects.

6. References

- Abdulameer, Z. A., & Sati' Abbas, S. (2020, July). Adaptive reuse as an approach to sustainability. In *IOP Conference Series: Materials Science and Engineering* (Vol. 881, No. 1, p. 012010). IOP Publishing.
- Armstrong, G., Wilkinson, S., & Cilliers, E. J. (2023). A framework for sustainable adaptive reuse: understanding vacancy and underuse in existing urban buildings. *Frontiers in Sustainable Cities*, 5. <https://doi.org/10.3389/frsc.2023.985656>
- Atapattu, K. A. M. R. P., EDIRISINGHE, E. N. M., Nissanka, S. P., Fernando, T. T., & Gunawardena, A. R. (2022). Estimation of Urban Green Cover Changes in Colombo Municipal Area over Ten Years Using Remote Sensing Techniques. *Chinese Journal of Urban and Environmental Studies*, 10(04), 2250026.
- Bottero, M., Oppio, A., Bonardo, M., & Quaglia, G. (2019). Hybrid evaluation approaches for urban regeneration processes of landfills and industrial sites: the case of the Kwun Tong area in Hong Kong. *Land Use Policy*, 82(August 2018), 585–594. <https://doi.org/10.1016/j.landusepol.2018.12.017>
- Bottero, M., D'Alpaos, C., Marelllo, A., 2020. An application of the A'WOT analysis for the management of cultural heritage assets: the case of the historical farmhouses in the Agli'e Castle (Turin). *Sustainability* 12 (3), 1071. <https://doi.org/10.3390/su12031071>.
- Bullen, P. A. (2007). Adaptive reuse and sustainability of commercial buildings. *Facilities*, 25(1–2), 20–31. <https://doi.org/10.1108/02632770710716911>
- Bullen, P. A., & Love, P. E. D. (2010). The rhetoric of adaptive reuse or reality of demolition: Views from the field. *Cities*, 27(4), 215–224. <https://doi.org/10.1016/j.cities.2009.12.005>
- Bullen, P., & Love, P. (2011). A new future for the past: A model for adaptive reuse decision-making. *Built Environment Project and Asset Management*, 1(1), 32–44. <https://doi.org/10.1108/20441241111143768>
- Conejos, S., & Langston, C. (2010). Designing for Future Building Adaptive Reuse using adaptSTAR. *Proceedings of the First International Conference on Sustainable Urbanization (Icsu 2010)*, (December 2010), 474–483. <https://doi.org/10.1504/JDR.2013.056589>
- Conejos, S., Langston, C., Chan, E. H., & Chew, M. Y. (2019). Governance of heritage buildings: Australian regulatory barriers to adaptive reuse. In *Building Governance and Climate Change* (pp. 160–171). Routledge.
- De Silva, G. D. R., Perera, B. A. K. S., & Rodrigo, M. N. N. (2019a). Adaptive reuse of buildings: The case of Sri Lanka. *Journal of Financial Management of Property and Construction*, 24(1), 79–96. <https://doi.org/10.1108/JFMPC-11-2017-0044>
- De Silva, G. D. R., Perera, B. A. K. S., & Rodrigo, M. N. N. (2019b). Adaptive reuse of buildings: The case of Sri Lanka. *Journal of Financial Management of Property and Construction*, 24(1), 79–96. <https://doi.org/10.1108/JFMPC-11-2017-0044>
- Department of Environment and Heritage (2004), Adaptive Reuse, Commonwealth of Australia, Department of Environment and Heritage, Canberra
- Douglas, J. (2006). *Building adaptation*. Routledge.
- Enache, M. (2014). Branding the Danish City Is Adaptive Reuse an option? *Globalization*.
- ICOMOS. (2010). ICOMOS New Zealand charter for the conservation of places of cultural heritage value (New Zealand charter).
- Jasim, S. A., & Ismaeel, E. H. (2023). The Most Appropriate Reuse of Historic Buildings. *International Journal of Sustainable Development and Planning*, 18(6), 1865–1875. <https://doi.org/10.18280/ijstdp.180622>
- Langston, C. A. (2008). The sustainability implications of building adaptive reuse. *Proceedings of CRIOCM 2008 International Research Symposium on Advancement of Construction Management and Real Estate*, 1–10.
- Love, P. (2011). Factors influencing the adaptive re-use of buildings. *Journal of Engineering, Design and Technology*, 9(1), 32–46. <https://doi.org/10.1108/17260531111121459>
- Macmillan, S. (2006). Added value of good design. *Building Research & Information*, 34 (3), 257–271. <https://doi.org/10.1080/09613210600590074>
- Mİslırlısoy, D., & Günçe, K. (2016). Adaptive reuse strategies for heritage buildings: A holistic approach. *Sustainable Cities and Society*, 26, 91–98. <https://doi.org/10.1016/j.scs.2016.05.017>
- Mohamed, N., & Alauddin, K. (2016). The criteria for decision making in adaptive reuse towards sustainable development. In *MATEC Web of Conferences* (Vol. 66, p. 00092). EDP Sciences.
- Rodson, D. (2002). *Geoffrey Bawa: The complete works*. London: Thames & Hudson.
- Samaranayake, R. A. D. I. U., Jayawickrama, T. S., Melagoda, D. G., & Rathnayake, R. M. D. I. M. (2019). Decision making on adaptive reuse of historic buildings in sri lanka. *World Construction Symposium*, (November), 239–247. <https://doi.org/10.31705/WCS.2019.24>
- Turkyilmaz, U., & Adilbekova, K. (2018). *Paris Congress on Social Sciences-I*.
- Vafaie, F., Remøy, H., & Gruis, V. (2023). Adaptive reuse of heritage buildings; a systematic literature review of success factors. *Habitat International*, 142, 102926.
- Vizzarri, C., Sangiorgio, V., Fatiguso, F., & Calderazzi, A. (2021). A holistic approach for the adaptive reuse project selection: The case of the former Enel power station in Bari. *Land Use Policy*, 111(October 2020), 105709. <https://doi.org/10.1016/j.landusepol.2021.105709>
- Wang, H. J., & Zeng, Z. T. (2010). A multi-objective decision-making process for reuse selection of historic buildings. *Expert systems with Applications*, 37(2), 1241–1249.
- Yung, E. H., & Chan, E. H. (2012). Implementation challenges to the adaptive reuse of heritage buildings: Towards the goals of sustainable, low carbon cities. *Habitat international*, 36(3), 352–361.

Annexure 01: Criteria affecting for successful adaptive reuse projects

Source- Developed by author using (Vizzarri et al., 2021) , (Samaranayaka et al.,2019), (Wang et al ,2010)

Criteria	Article	Definition
Greenery	Giuliani et al. (2017), Oppio et al.(2018), Bottero et al.(2018), Bottero et al.(2019c), Berta et al.(2016), Ferretti and Grosso(2019),Vizzarri et al.(2021)	The presence of green areas in the transformation project
Environmental impact	Berta et al.(2016), AdriFort(2015), Yau(2009), Vehbi et al.(2021),Vizzarri et al.(2021)	The possible risks and negative Criteria that can affect building renovation processes.
Gentrification	Berta et al.(2016), Ferretti and Grosso(2019),Vizzarri et al.(2021)	The level of renovation and improvement of the district after transformation.
Public space surface	Bottero et al.(2019a) , Oppio et al.(2018), Bottero et al.(2018), Bottero et al.(2019c), Della Spina(2019),Vizzarri et al.(2021)	The presence of public spaces for the local community, quantifying, for each scenario, the total surface used to host walking areas
Safety and security	Berta et al.(2016), Pinto et al.(2017),Vizzarri et al.(2021)	The presence of company and site security and safeguard systems.
Site attractiveness	Oppio et al.(2018), Bottero et al.(2019c), Berta et al.(2016), Oppio and Bottero(2017),Vardopoulos (2019), Ferretti and Grosso(2019), Della Spina(2019), Vehbi et al.(2021), Ribera et al.(2019), Turskis et al.(2017),Vizzarri et al.(2021)	The presence of leisure activities that could contribute to attract both inhabitants and visitors in the area
Liveability	Giuliani et al. (2017), Oppio et al.(2018), Bottero et al.(2019c), Berta et al.(2016),Vardopoulos (2019), Zavadskas and Antucheviciene(2006), Pinto et al.(2017),Vizzarri et al.(2021)	The future quality of life after the transformation process.
Walkability	Giuliani et al. (2017), Oppio et al.(2018), Yau(2009),Vizzarri et al.(2021)	The project capability to manage people flows
Raising public awareness	(Al-hagla, 2010; Astill, 2000; Chen et al., 2018; Conejos et al., 2016; Djebbour & Biara, 2020; Ho & Hou, 2019; Hou & Wu, 2020; Lah, 2019)	Planning Interpretive programs such as publications, lectures, on-site info, and illustration to raise awareness of local residents, tourists, and the general public about reuse project/educational value
Cultural Value	Wilkinson(2011),O'Donnell (2004), Myers and Wyatt (2004), Bullen and Love (2011), Langston et al. (2008), Langston (2012), Hong and Chen (2017)	The cultural identity of the place/building due to the potential feature that it has
Profitability	Oppio et al.(2017), Bottero et al.(2018), Berta et al.(2016), Oppio and Bottero(2017), Yau(2009), Vardopoulos (2019), Della Spina(2019), Vehbi et al.(2021),Vizzarri et al.(2021), Wilkinson(2011)	The transformation profit in relation to the size of business. In particular, the business's ability to produce a return on an investment, considering the services and the market influence of that type of transformation is considered
Economic feasibility	Giuliani et al. (2017), Bottero et al. (2020), Bottero et al.(2018), Berta et al.(2016), Oppio and Bottero(2017), Haroun et al.(2019), Della Spina(2020), Mecca(2018), Ferretti and Grosso(2019), Vehbi et al.(2021), Giove et al.(2011), Turskis et al.(2017),Vizzarri et al.(2021), Wilkinson(2011)	The project costs in effort to determine whether or not it is logical and possible its realization.
Self Sustaining	(Murtagh, 2006; Shipley et al., 2006; UNESCO, 2007, pp. 2000–2004; Remøy et al., 2007; Suratkon & Ando, 2010; Wang & Zeng, 2010; Yung et al., 2014; Mısırlısoy and Günçe, 2016c; Aigwi et al., 2018; Chen et al., 2018; Mohd Abdullah et al., 2020)	The possibility of the historic building becoming self-sustaining if there is a potential market for the new use
Attractive location	(McCormick, 2002) (Shipley et al., 2006; Langston et al., 2008; Bullen & Love, 2010, 2011; Yung & Chan, 2012a; Aigwi et al., 2018, 2020; Lo Faro & Miceli, 2019)	The attraction of the site/location with good topography, plot size, and scenery for tenants and buyers
Functional Potential	Oppio et al.(2017), Bottero et al.(2019c), Haroun et al.(2019), Pinto et al.(2017), Giove et al.(2011), Ribera et al.(2019),Vizzarri et al.(2021), Gann and Barlow (1996), Fianchini (2007), Rawlinson and Harrison (2009), Bullen and Love (2011), Wilkinson (2014), Manewa et al. (2016)	The presence of activities useful for district development and city regeneration.
Services	Giuliani et al. (2017), Ferretti et al (2014), Oppio et al.(2018), Bottero et al.(2019b), Della Spina(2020), Della Spina(2019), Vehbi et al.(2021),Vizzarri et al.(2021), Wilkinson(2011)	The number of functions inserted in the project

Accessibility	Giuliani et al. (2017), Ferretti et al (2014), Bottero et al. (2020), Bottero et al.(2019a), Oppio et al.(2018), Bottero et al.(2019b), Bottero et al.(2019c), Berta et al.(2016), Oppio and Bottero(2017), Haroun et al.(2019), Dabouh and El Shazly(2020), Stanojevic et al.(2019), Della Spina(2020), Yau(2009), Giove et al.(2011),Vizzarri et al.(2021)	Involves both the pedestrian and car accessibility
Dismantlability	Berta et al.(2016), AdriFort(2015), Pinto et al.(2017), Giove et al.(2011),Vizzarri et al.(2021), Blakstad(2001) , Robertson and Sribar (2002), Douglas (2006), Geraedts(2008)	The possibility to easily disassemble unused building parts, reusing it in the transformation process
Interaction with urban shape	Bottero et al. (2020), Oppio et al.(2017), Oppio and Bottero(2017), Mecca(2018),Vizzarri et al.(2021)	The project relates with the urban and building asset and shape. Interaction deals with the opportunity to create synergies between the transformed area and the surrounding district in terms of urban city typological structure
Space flexibility	Ferretti et al (2014),Bottero et al. (2020), Bottero et al.(2019b), Oppio and Bottero(2017), Haroun et al.(2019), AdriFort(2015), Stanojevic et al.(2019), Della Spina(2020), Mecca(2018), Claver et al.(2018), Della Spina(2019), Pinto et al.(2017), Vehbi et al.(2021), Giove et al.(2011), Turskis et al.(2017),Vizzarri et al.(2021),Gann and Barlow (1996), Swallow (1997), Fianchini (2007), Szarejko and Trocka-Leszczynska (2007), Bullen and Love (2011), Hong and Chen (2017)	The possibility to maintain the readability of the building from both its original function and original structure point of view
Demolished Buildings	Vizzarri et al.(2021)	The number of demolished buildings to accomplish site conversion.
Architectural quality	Oppio et al.(2018), Bottero et al.(2019b), Haroun et al.(2019), AdriFort(2015), Dabouh and El Shazly(2020), Stanojevic et al.(2019), Mecca(2018), Yau(2009), Vardopoulos (2019), Claver et al.(2018), Zavadskas and Antucheviciene(2006), Pinto et al.(2017), Vehbi et al.(2021), Giove et al.(2011), Ribera et al.(2019), Turskis et al.(2017),Vizzarri et al.(2021), Wilkinson(2011), Brereton (1995), Ball (2002), Snyder (2005), Bullen and Love (2011), Hong and Chen (2017)	The aesthetic quality of the project (building artistic and historic value of the existent).
Minimum intervention	(DEH, 2004; Douglas, 2006; ICOMOS, 2000; The Charter of Krakow, 2000) (The Secretary of the Interior's Standards for Rehabilitation, 2006; Theologidou, 2007; Langston, 2011; Yung & Chan, 2012a; Philokyprou, 2014; Dyson et al., 2016; Conejos et al., 2016; Conejos et al., 2017; Sjöholm, 2017; Barranha et al., 2017; Chen, Chiu, & Tsai, 2018; Othman & Elsaay, 2018; Lah, 2019; Lo Faro & Miceli, 2019; Nestico & Somma, 2019; Djebbour & Biara, 2019; Djebbour & Biara, 2020)	Minimum intervention, defining suitable changing levels. Considering the basic structure and character of the building to be intact
Explicitness of alterations	Elkerdany, 2002; ICOMOS, 1964; ICOMOS, 2004; Matero, 2006) (The Secretary of the Interior's Standards for Rehabilitation, 2006; Torres, 2009; Günçe & Mısırlısoy, 2014; Philokyprou, 2014; Lombardi et al., 2015; Shehata et al., 2015; Barranha et al., 2017; Djebbour & Biara, 2019; Lah, 2019; Md Ali et al., 2019; Stival et al., 2020)	The architectural style after reuse should not falsify the record of the past and new changes should be distinguishable for future generations
Analysis and assessment of structural layout	Hickey, 2005; Douglas, 2006; Itard & Klunder, 2007; Architectural Institute of Japan, 2007; Barrett, 2009; Gibson, 2009; De Berardinis & Rotilio, 2009; Suratkon & Ando, 2010; Plevioets & Van Cleempoel, 2011; Bullen & Love, 2011; Remøy & Wilkinson, 2012; Cramer & Breitling, 2007; Yildirim, 2012; Philokyprou, 2014; Dyson et al., 2016; Conejos et al., 2016; Wells & Lixinski, 2017; De Berardinis, Rotilio, & Capannolo, 2017; Conejos et al., 2017; Besana et al., 2018; Brooker & Stone, 2017; Aigwi et al., 2018; Mohd Abdullah, Suratkon, & Syed Mohamad, 2020; Stival et al., 2020)	The structural alterations to old buildings should be analyzed/ assessed by expert consultants for conversion, level of intervention, safety indicators, and historical building envelope (integration, insertion, addition, etc.)
Upgrading physical characteristics around	(Atash, 1993; Chen et al., 2018; Conejos et al., 2017; Douglas, 2006; Jonas, 2006; Lah, 2019; Yung & Chan, 2012a)	The reuse project should contribute to the improvement of the physical characteristics of surrounding areas, acting as a catalyst for urban upgrading
Age value of materials	(Cassar, 2009; Douglas-Jones et al., 2016; Holtorf, 2013; Lowenthal, 1985; Riegl, 1982; Unnerbäck, 2000)	Considering the "Age Value" of materials and aesthetic qualities of harmony and beauty in decay, patina, disintegration
Predicting seismic resilience	(Bruneau et al., 2003; Prime Ministerial Directive, 2007; Bellicoso, 2011; Philokyprou, 2014; Aigwi et al., 2018; Aigwi et al., 2020)	The structural stresses from seismic action must be less than the ability of the existing structure to absorb, seismic resilience in emergency situations

Load- bearing structure	(Aigwi et al., 2018; Douglas, 2006; Highfield & Gorse, 2009)	Technical improvement of the load-bearing structure, building envelope
Technological innovations	(Bullen & Love, 2011; Burns, 2014; Conejos et al., 2016; Shipley et al., 2006; Wilkinson et al., 2009; Wilkinson & Remøy, 2018; Wilkinson et al., 2014)	The potential of the building for innovative construction finishes, consistent with current technical trends
Orientation and solar access	(Bullen & Love, 2010; Bullen & Love, 2011; Burns, 2014; Conejos et al., 2014; Conejos et al., 2017; Lombardi et al., 2015; Shipley et al., 2006; Wilkinson et al., 2009; Wilkinson & Remøy, 2018; Wilkinson et al., 2014)	The importance of building orientation for providing opportunities for passive solar strategies
Respecting the preservation rules and provisions	(Building Act, 2004; Suratkon & Ando, 2010; Bullen & Love, 2011; Wilson, 2010; Othman & Elsaay, 2018; Lynch & Proverbs, 2020; Aigwi et al., 2020; Mohd Abdullah et al., 2020)	Preserving the significant features with heritage value according to the international and national provisions
Compatibility with zoning and (urban)planning requirements	(Mosetto & Vecco, 2001; De La Torre, 2002; Shipley et al., 2006; Wang & Zeng, 2010; Conejos et al., 2014; Conejos et al., 2017; Giuliani et al., 2018; Aigwi et al., 2018, 2020; Djebbour & Biara, 2019; Nestico & Somma, 2019; Lo Faro & Miceli, 2019; Mohd Abdullah et al., 2020)	The reuse project should meet the current urban master plan, zoning and planning specification
Public-private partnerships	(Conejos et al., 2014; Giuliani et al., 2018; Lo Faro & Miceli, 2019; Yildirim & Turan, 2012)	The important role of public-private partnerships as a fundamental element for the economic, social, and other success Criteras of reuse

Annexure 2: Method of data collecting for criteria (Source- Developed by author)

Sub Criteria	Method of data collection
Greenery	Satellite image comparing
Environmental impact	Documents
Gentrification	User Interviews, Documents
Public space surface	Documents
Safety and security	User Interviews and Observations
Site attractiveness	Market Analysis
Livability	Observations
Walkability	Google Earth Pro & Google maps
Raising public awareness	Checking websites, User Interviews
Cultural Value	User Interviews
Profitability	Documents regarding Discounted Cash Flow
Economic feasibility	Feasibility Analysis Documents
Self-Sustaining	Observations, Interviews
Attractive location	Google Earth Pro & Google maps
Functional Potential	User Interviews
Services	Google Earth Pro & Google maps
Accessibility	Documents
Dismantlability	User Interviews
Interaction with urban shape	Observations & User Interviews
Space flexibility	Photo Analysis and User Interviews
Demolished Buildings	Satellite images comparing
Architectural quality	Observations & User Interviews
Minimum intervention	User Interviews
Explicitness of alterations	observations
Analysis and assessment of structural layout	Documents, reports, website information
Upgrading physical characteristics around	Observations
Age value of materials	User Interviews
Predicting seismic resilience	Documents, reports
Load- bearing structure	Documents, reports
Technological innovations	Documents, reports
Orientation and solar access	Observations.
Respecting the preservation rules and provisions	Documents
Compatibility with zoning and (urban)planning requirements	Documents
Public-private partnerships	Documents